Characterizing interactions between earthquake rupture and fault zone structure

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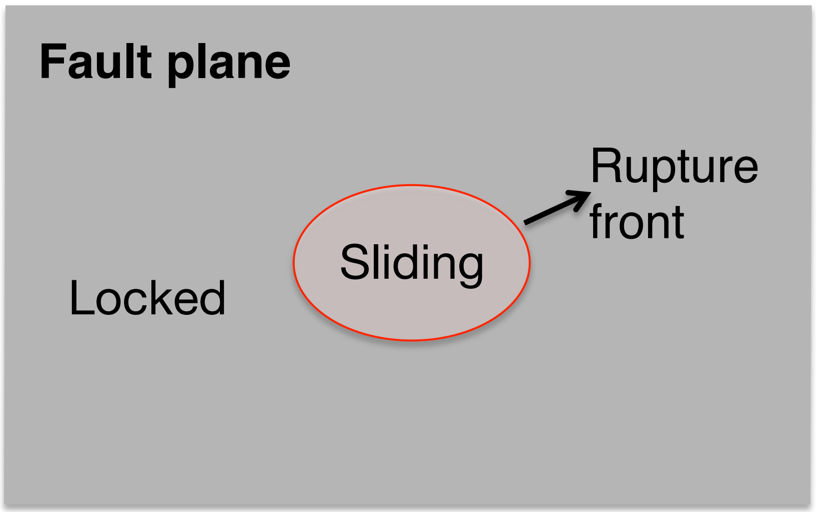
DFZs are detected by seismic waves

Table 1. Summary of Material Properties of Main Fault Zones

Fault Zones	Width (m)	Velocity Reduction (%)	Q_s
San Andreas	~ 150	30–40	10–40
	~ 200		
San Jacinto	125–180	35–45	20–40
	150–200	25–60	
Landers	270–360	35–60	
	150–200	30–40	20–30
Hector Mine	75–100	40–50	10–60
Calico	~ 1500	40–50	
	~ 1300	40–50	
Nojima	100–220		
Anatolian	~ 100	50	10–15

[Huang et al., 2014]

How can DFZs change earthquake rupture?



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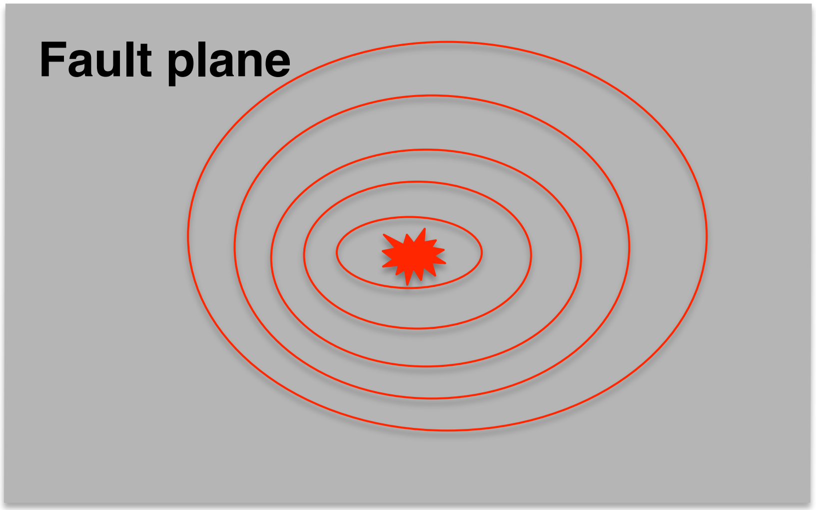

Rupture speed is how fast the rupture front propagates.

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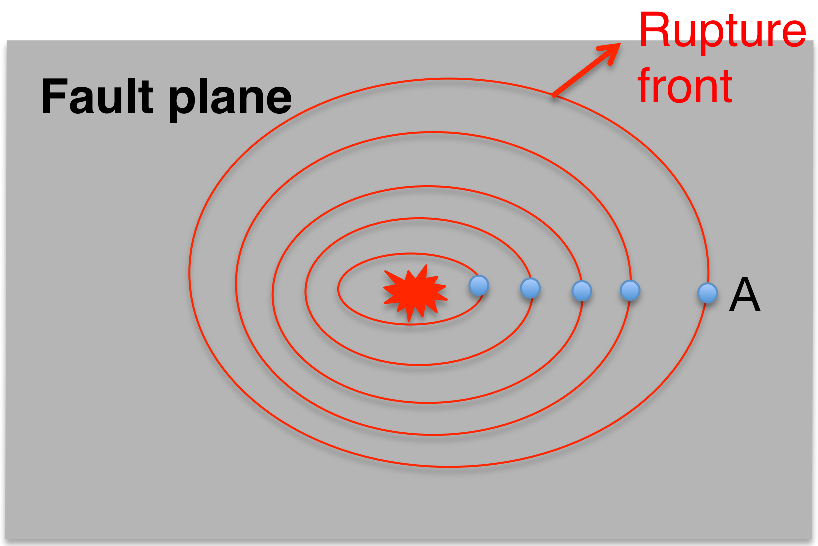
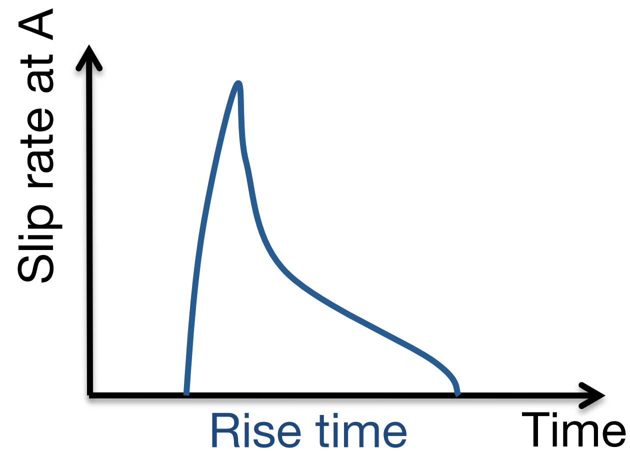
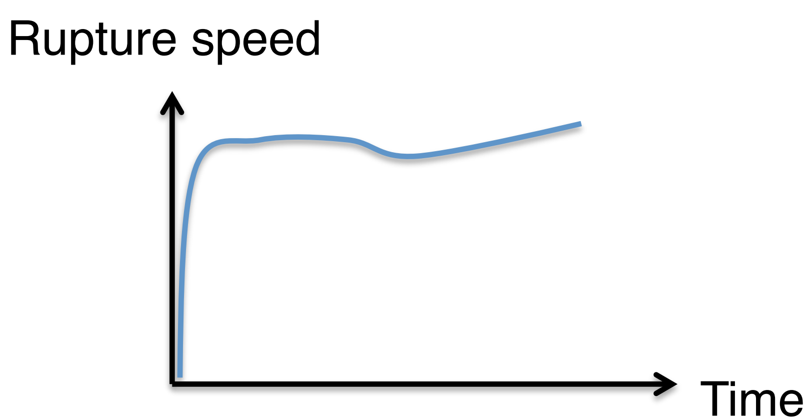
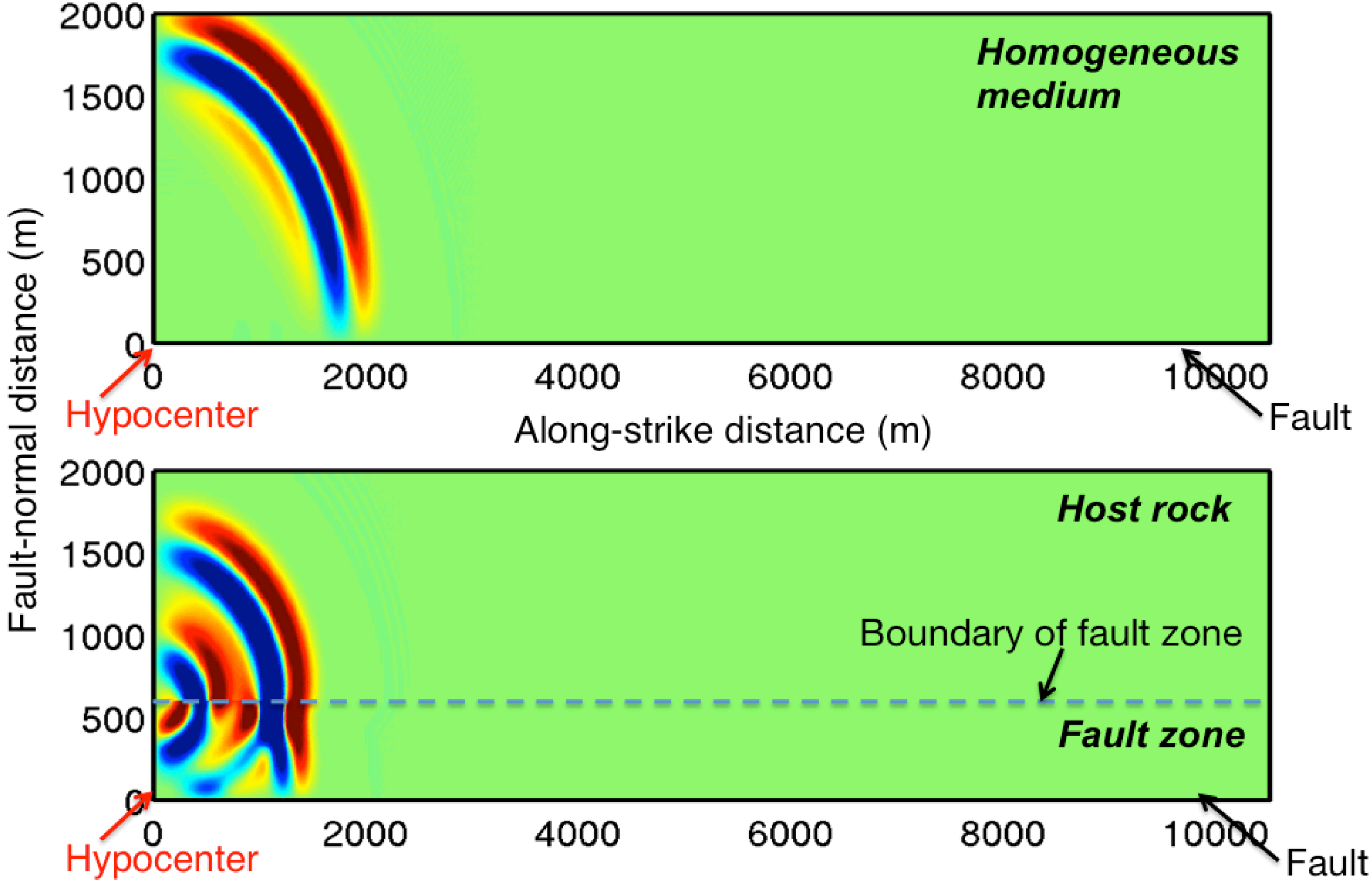






DFZs trap waves and induce fault stress changes



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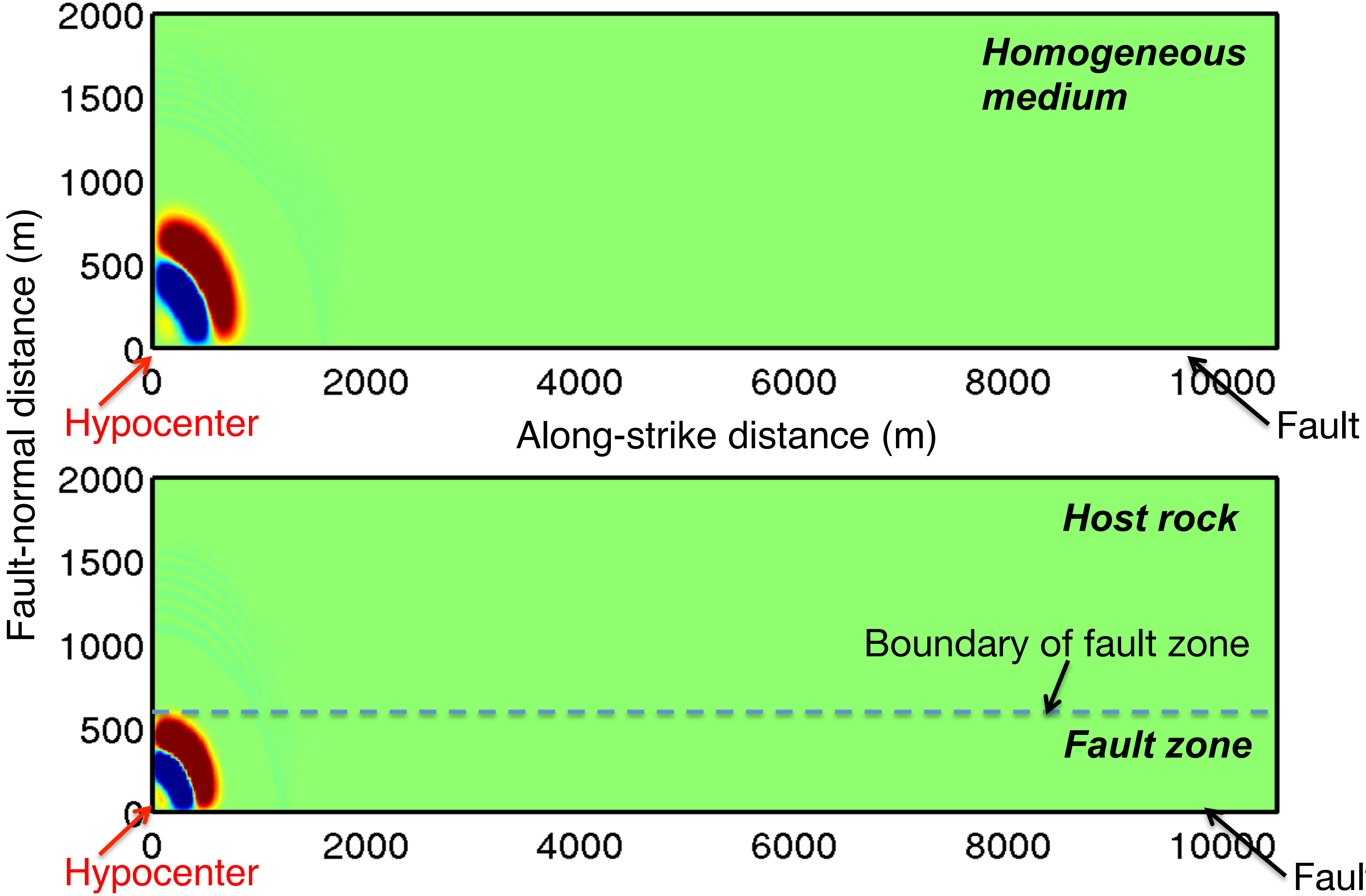

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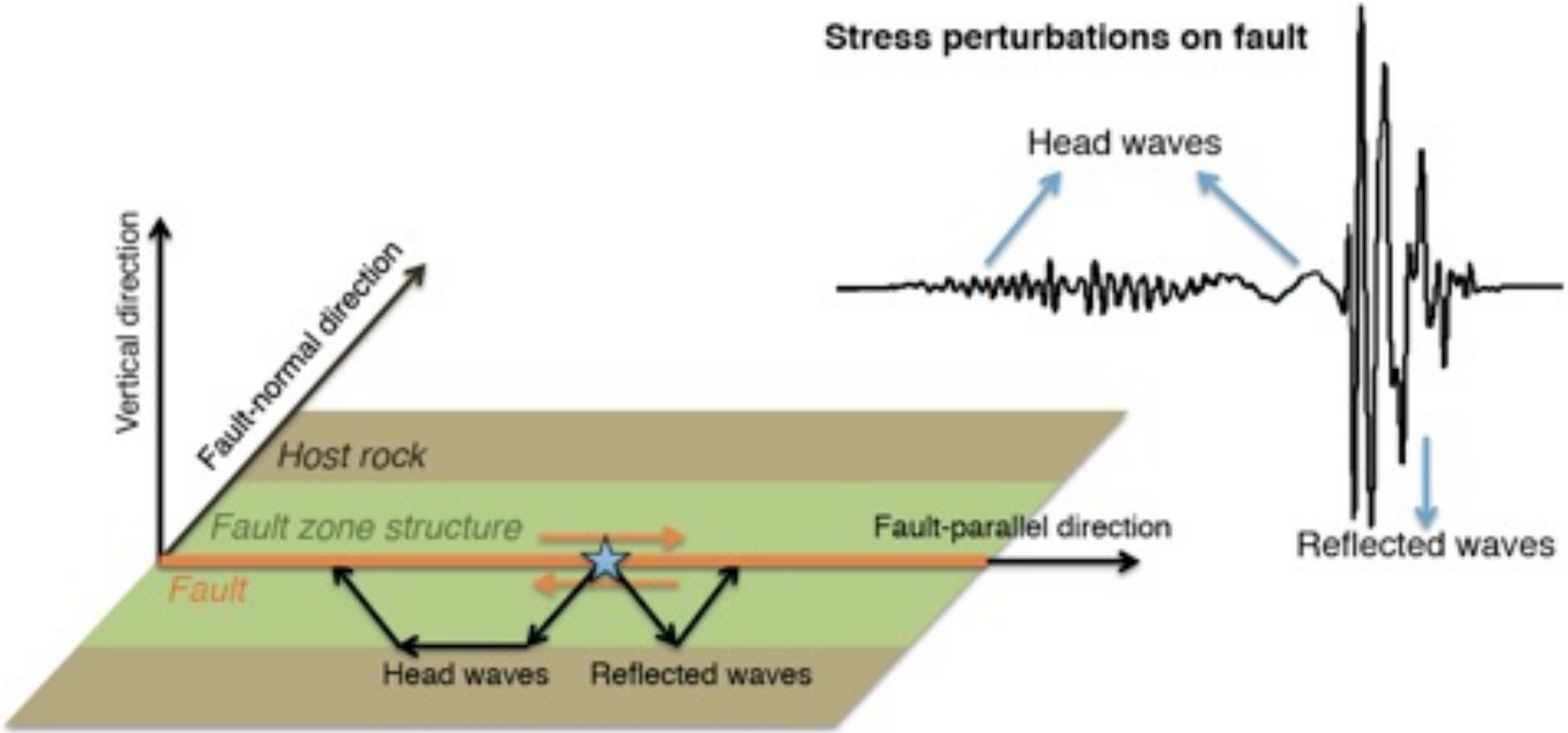
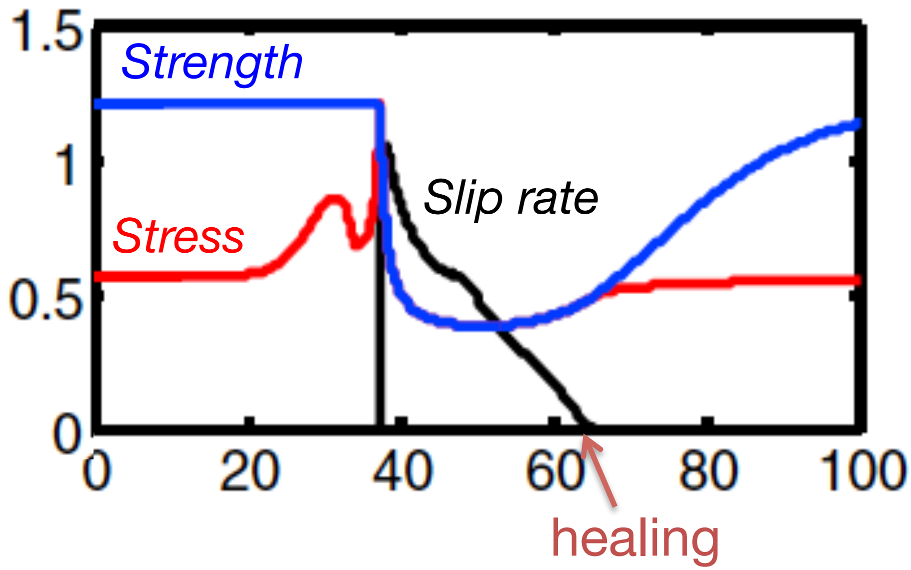
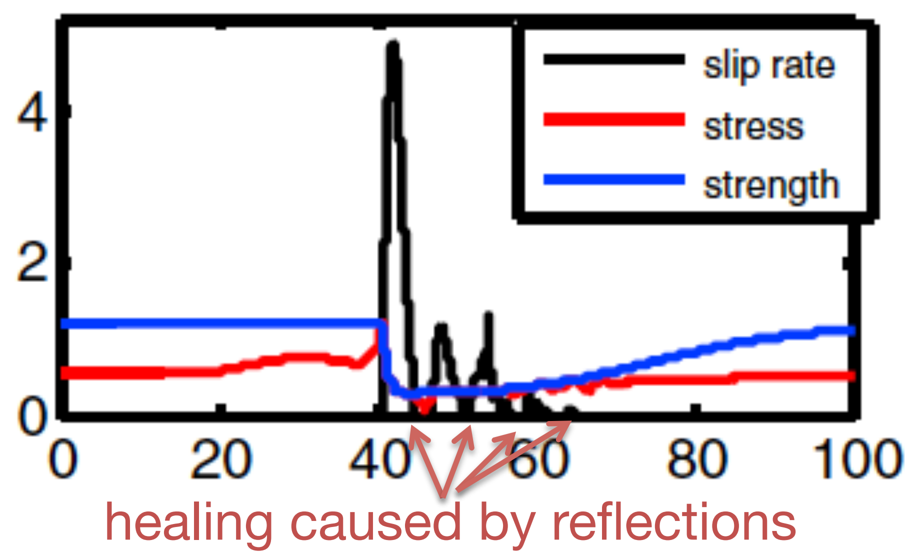


Slip rate functions are altered by DFZ reflections

Homogeneous medium



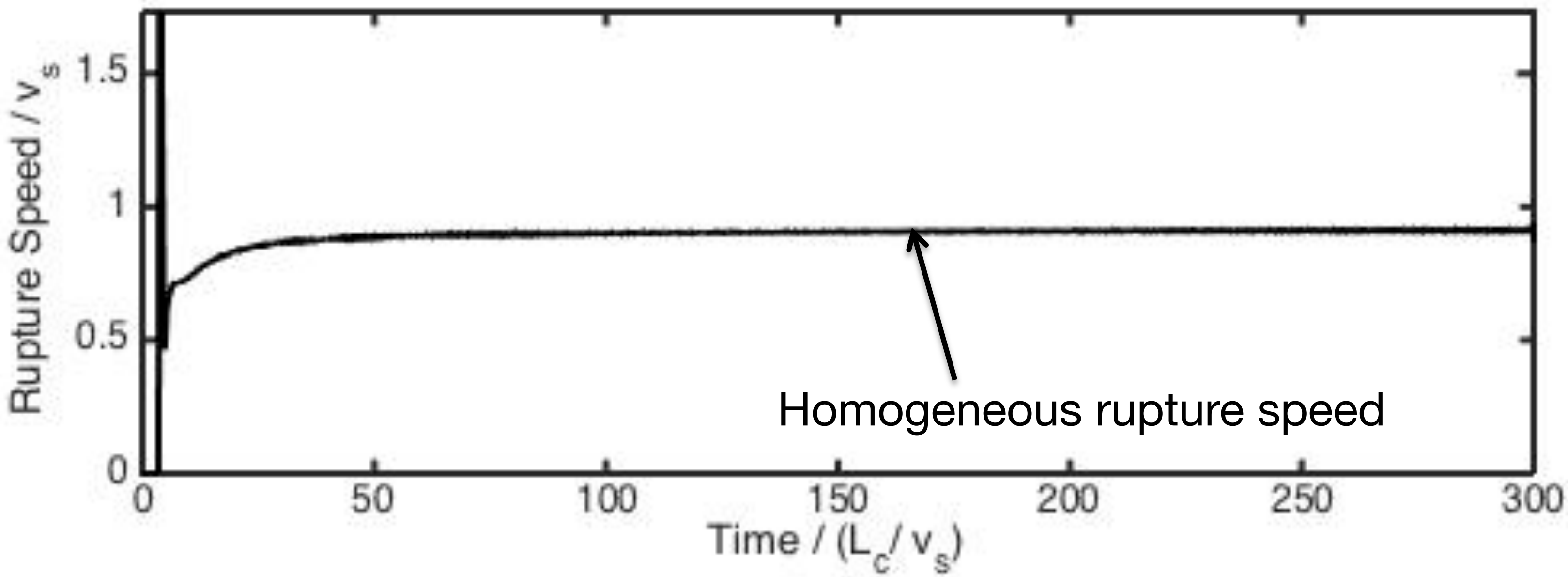
Damaged fault zones



(More high-frequency ground motion!)

[Huang and Ampuero, 2011; Huang et al., 2014]

Rupture velocity is accelerated by head waves



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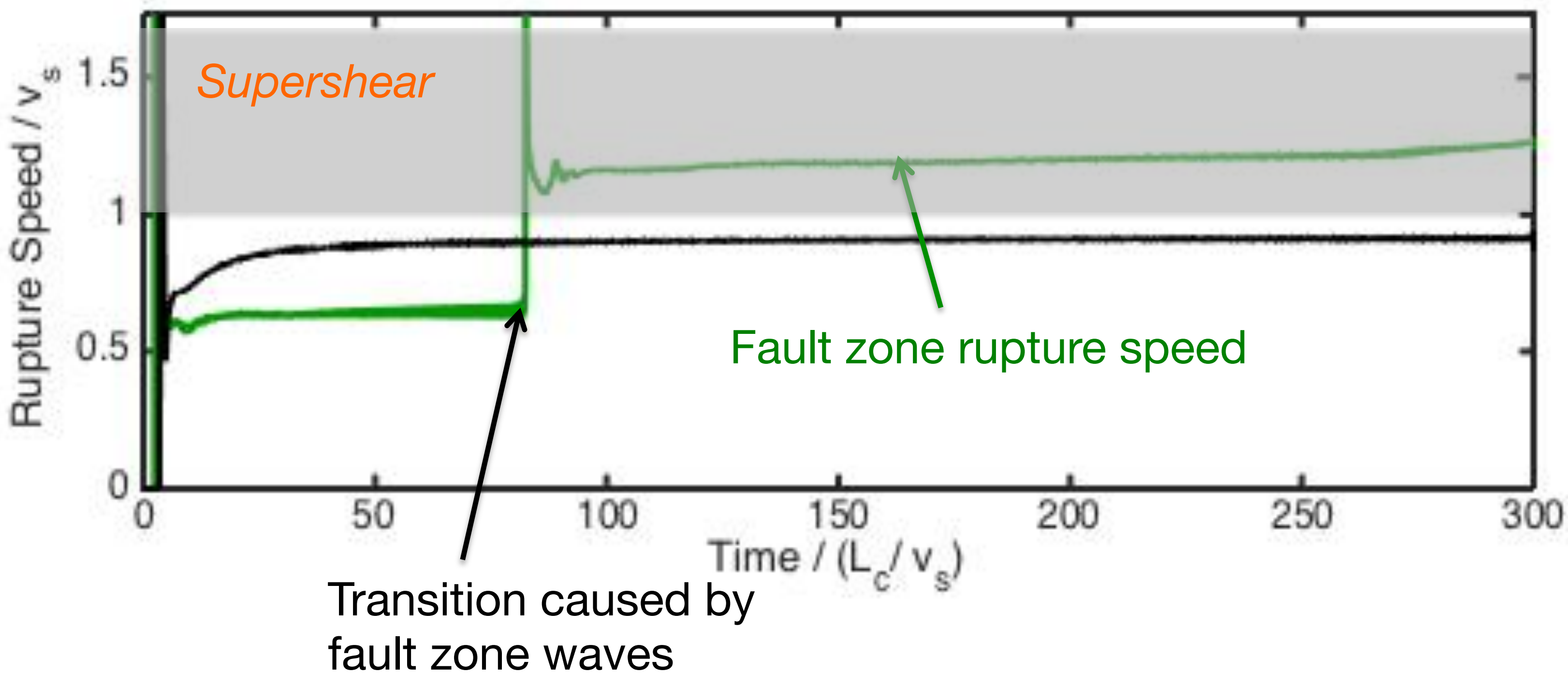
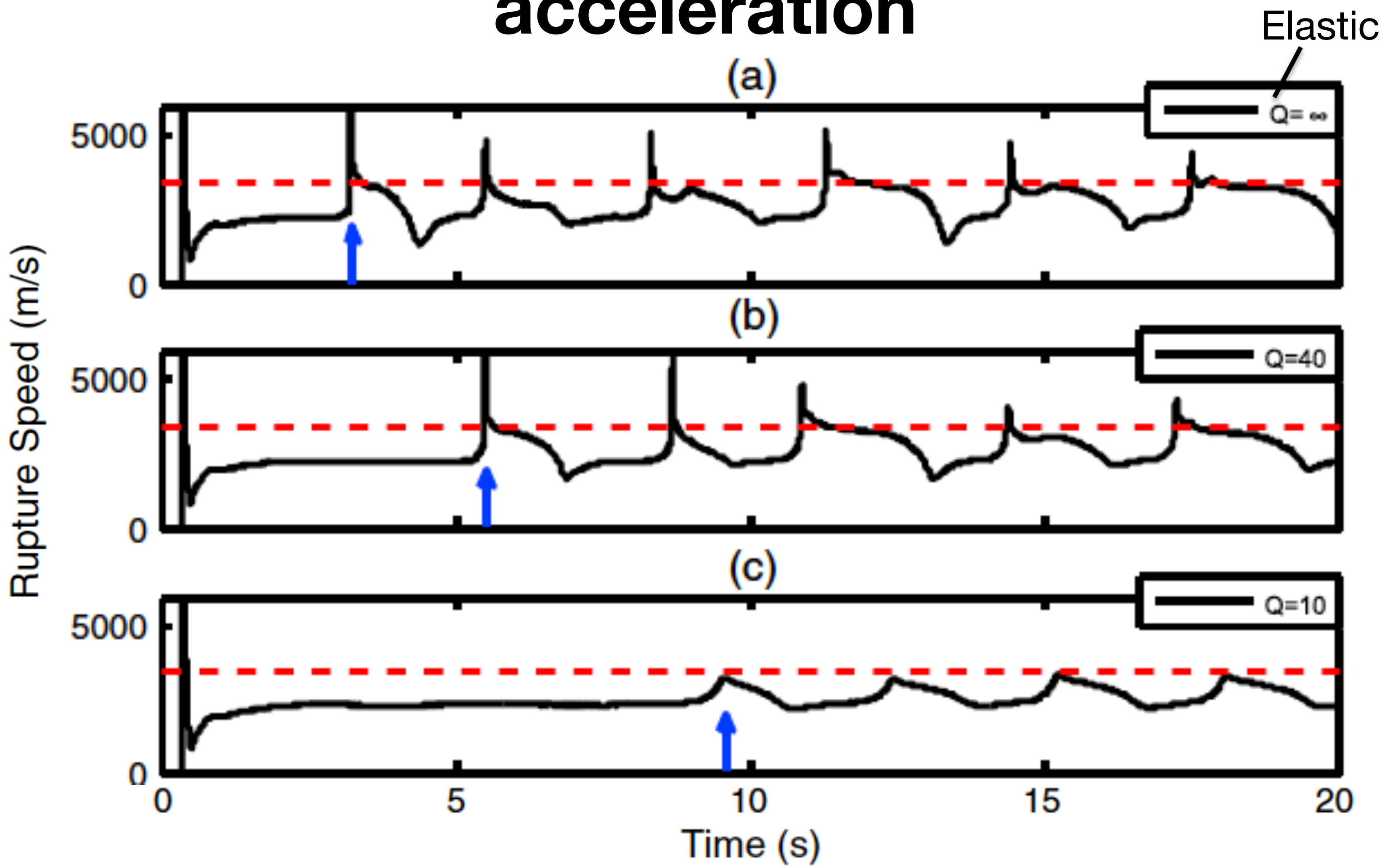


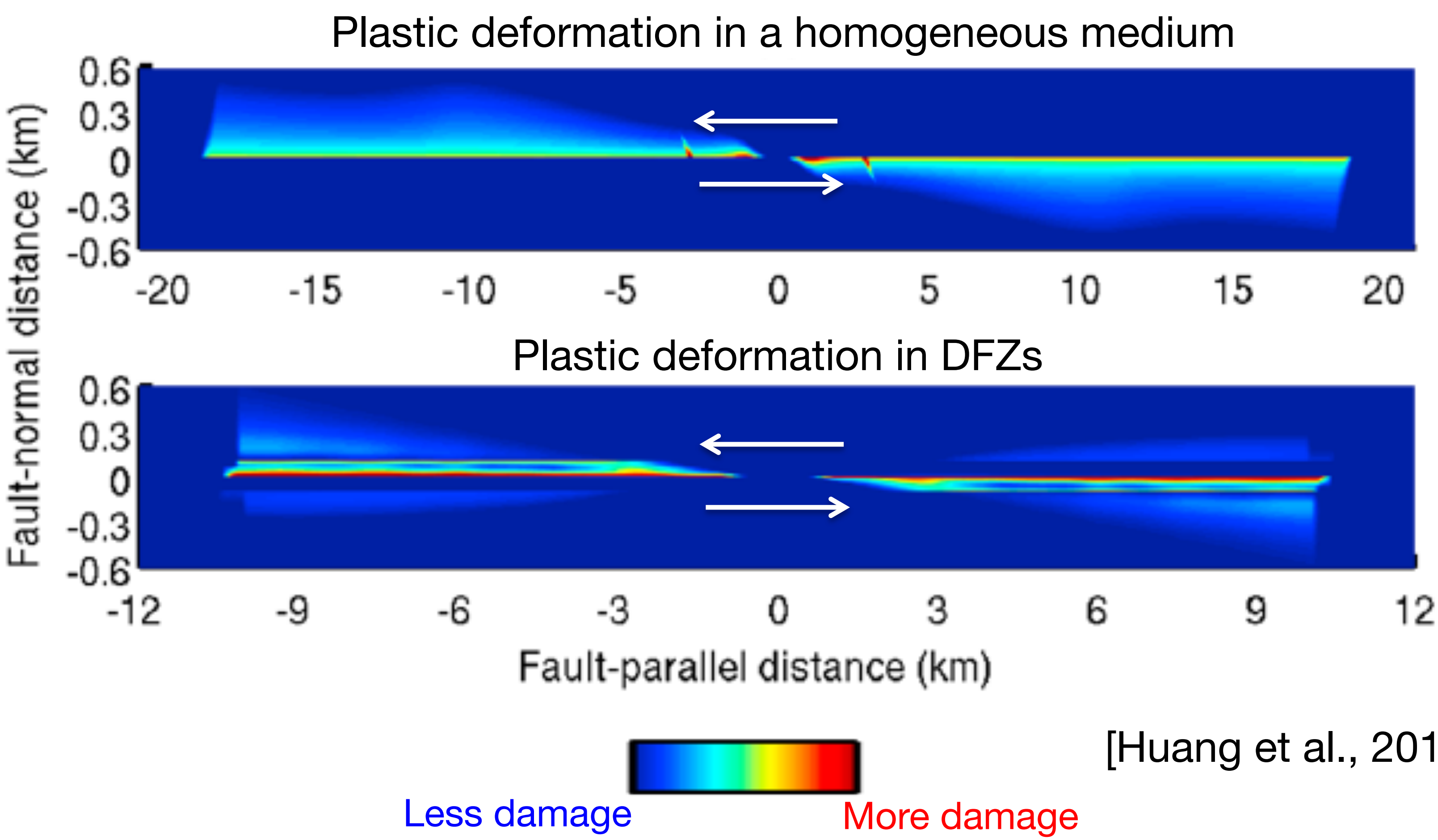
[Huang et al., 2014, 2016]

Large attenuation delays rupture acceleration



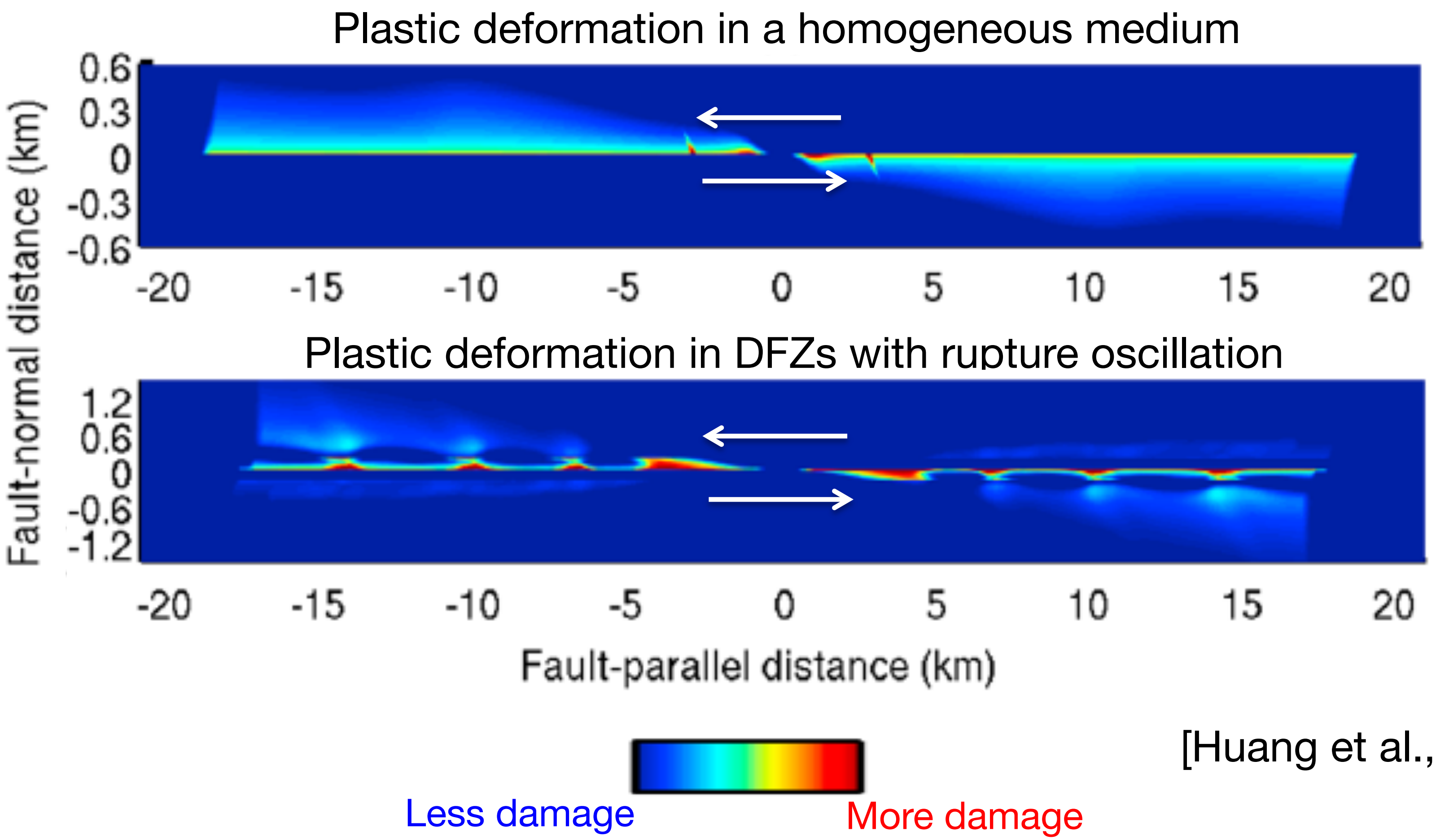
[Huang et al., 2014]

Earthquakes cause DFZ damage on both compressional and extensional sides



[Huang et al., 2014]

DFZ damage preserves rupture pattern of previous earthquakes



[Huang et al., 2014]

Earthquake cycle models are needed to understand DFZ development